X-ray transient galaxies and AGN

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Abstract. X-ray transience is the most extreme form of variability observed in AGN or normal in-active galaxies. While factors of 2-3 on timescales of days to years are quite commen among AGN, X-ray transients appear only once and vanish from the X-ray sky years later. The ROSAT All-Sky Survey was the tool to discover these sources. X-ray transience in AGN or galaxies can be caused by dramatic changes in the accretion rate of the central black hole or by changes of the properties of the accretion disk.

1 Introduction

Our sample of soft X-ray AGN contains 113 sources selected from the ROSAT All-Sky Survey (RASS, [12]) by the PSPC count rates CR > 0.5 cts s^{-1} and the hardness ratio HR <0.0. Pointed PSPC and HRI observations are available for 60 and 50 sources, respectively. All in all, for more than 80 sources at least one pointed observation is available [7]. In this way we have a tool to search for long-term large amplitude variations. Fig. 1 displays the RASS vs. pointed observation count rates. HRI count rates have been converted into PSPC count rates assuming no spectral change between both observations. The solid line marks no change, the short-dashed line a change by a factor of 10 and the long-dashed line by a factor of 100 between the RASS and the pointed observation. Four sources turned out to vary by factors of almost 100 or even more: **WPVS 007, IC 3599, RX J1624.9+7554**, and **RX J2217.9–5941**. The first three are X-ray transients while RX J2217.9–5941 is a possible X-ray transient candidate.

2 X-ray transient sources

2.1 WPVS 007

The Narrow-Line Seyfert 1 galaxy (NLS1) WPVS 007 was *the* softest AGN observed during the RASS [5] and had a mean count rate of about 1 cts s^{-1}. In later pointings the source shows only the flux expected from a normal inactive galaxy. A possible scenario to explain this dramatic turn-off is a temperature change in the Comptonization layer of the accretion disk that shifts the soft X-ray photons out of the ROSAT energy window.

2.2 IC 3599

The Seyfert 2 galaxy IC 3599 has shown an X-ray outburst during the RASS followed by a response in its optical emission lines ([4], [2]). A possible explanation of this X-ray outburst is an accretion event either caused by an instability of the accretion disk or by a tidal disruption of a star orbiting around the central black hole.

2.3 RX J1624.9+7554

RX J1624.9+7554 has shown a dramatic derease of its X-ray flux by at least a factor of more than 200 between the RASS and a pointed observation 1.5 years later (Grupe et al. 1999). Optical spectroscopy identified this source as a normal in-active galaxy. The most plausible explanation for this X-ray event is the tidal disruption of a star by the central black hole. Other in-active galaxies in which an X-ray outburst have occured are NGC 5905, RX J1242.6–1119 ([10], [9]; see also S. Komossa's contribution in these proceedings), and RX J1420.4+5334 [3].

2.4 RX J2217.9–5941

The NLS1 RX J2217.9–5941 is a possible X-ray transient candidate. It is highly variable on time scales of days as well as years [8]. During its two-day

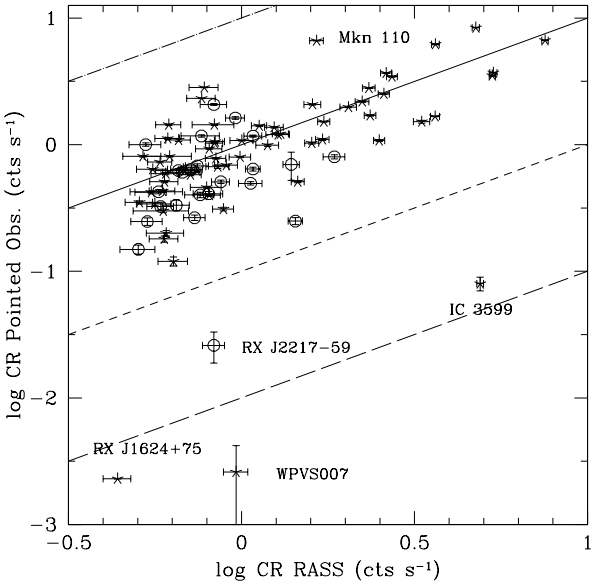

Fig. 1. RASS vs. pointed observation count rates

RASS observation the count rate decrease by a factor of 15. Observed several times in pointed observations by ROSAT and ASCA the source has become fainter over the years. It is not clear yet if this source will become a transient. However, due to the black hole mass of $\approx 10^8 M_\odot$ the timescales are larger than in e.g. IC 3599 ($M_{BH} \approx 10^6 M_\odot$).

3 Discussion

The nature of X-ray transient sources is of different origin. While in WPVS007 the question is why its X-ray source is off right now, the question for IC 3599 and RX J1624.9+7554 is what was the reason for the outburst. The X-ray flux seen in WPVS007 during the RASS is in good agreement what is expected from the mean optical to X-ray flux ratio (see [1]). A possible explanation is a temperature change in the Comptonization layer above the disk that shifts the UV photons into the soft X-ray range [5] and caused that the observed spectrum is shifted out of the ROSAT PSPC energy window. The outburst in IC3599 and RX J1624.9+7554 can be explained by accretion events, e.g. the tidal disruption of a star that comes to close to the central black hole, a scenario that has been suggested by e.g. [11]. Such X-ray outburst events are rare. However, performing new soft X-ray surveys in order to find more of these x-ray transient sources. Quick follow-up observations in the optical and in X-rays would provide as with a powerful tool to map the inner region of an AGN or galaxy while the light front is passing through the inner region of the AGN.

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